An Analysis of User Needs and Specifications for a Geographic Information System in the Integrated Forest Protection Demonstration Area

Robert M. Itami

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Robert M. Itami
Assistant Professor
Division of Landscape Resources
School of Renewable Natural Resources
University of Arizona
Tucson, Arizona 85721

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SUMMARY

This report provides the results of a cooperative agreement to determine specifications for a GIS system for the IFP Demonstration in the Jemez District of the Santa Fe National Forest. The report summarizes the methods and results of the user needs survey. Results of the survey point out specific problems relating to the demonstration. These include the 1) wide range of computer literacy; 2) differences in objectives and analytical needs between managers and policy makers on the one hand and researchers and resource analysts on the other hand; 3) the wide geographic distribution of the participants in the demonstration and 4) the advantages of the small study area. These conclusions were then used as a basis for specifying optional GIS systems configurations. Recommendations regarding price and performance are provided to assist in decision making.

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I. INTRODUCTION

A. Purpose of Study

The primary purpose of this study is to analyze the needs of the various participants in the Integrated Forest Protection (IFP) Demonstration Area for Geographic Informations Systems (GIS) technology. This study includes an analysis of user needs and responsibilities in the IFP demonstration project along with data requirements, and GIS functional capabilities as a basis for specifying a GIS environment suitable for the IFP demonstration.

B. Procedures

The systems specification for GIS is based on a systematic assessment of the various participants in the IFP demonstration to determine their 1) role in the the demonstration; 2) specific responsibilities; 3) data needs; 4) analytical needs 5) current computer literacy and use patterns in general and; 6) statistical and GIS use specifically.

In addition, an overall assessment of the current computing environment is also assessed to determine the possibilities of retrofitting GIS technology within the existing environment and anticipating possible conflicts or incompatibilities with existing functions and operations should a new system be installed.

The emphasis of the study focuses specifically on the research needs for the IFP demonstration. However care has been taken to determine the day to day needs of the forest managers and resource analysts and how these long term needs may be accomodated within the context of the current demonstration.

The procedures used in collecting information from users included a questionnaire and personal interviews. This information was then compiled and conclusions drawn relating to the technical

requirements for a GIS system. Finally various configurations are presented with various advantages and disadvantages outlined for each option.

II. USER NEEDS SURVEY

A survey questionnaire was sent to a list of participants and interested parties in the IFP demonstration. The complete questionnaire is included in Appendix II. Included with the questionnaire were two brief documents prepared to provide background information to participants in the survey. The first document describes the purpose of the IFP demonstration and is included in Appendix III. The second document describes the purpose of the GIS in the demonstration and is included in Appendix IV. The results of the user survey are summarized in Appendix V. The results of the data inventory are reported in full in Appendix VI. The complete list of respondents is found in Appendix VII. The following is a discussion of the results of the survey with a discussion of the implications for the GIS specification.

A. User characteristics

The survey was mailed to 14 different groups representing over 20 individuals with either direct responsibility in the IFP demonstration or related interest in the project. The list was compiled by Brian Geils in the Rocky Mountain Forest and Range Experiment Station. Out of the 14 groups on the mailing list, 11 respondents returned the questionnaires. With one exception, the forms were filled out completely. The remaining 10 questionnaires form the basis for this study. The first part of the survey related to user characteristics and requirements. The results of these questions are discussed below:

1. Responsibilities and objectives in the IFP demonstration. The first three questions in the survey addressed the issue of responsibility in the IFP demonstration (Question 1), management and research objectives (Question 2), and a categorization of primary roles in the IFP demonstration. The results of these questions showed that a wide range roles and responsibilities were represented in the respondents. Many of the respondents indicated involvement in two or more areas of responsibility. The results are summarized below:

*Respondent:	1	2	3	4	5	6	7	8	9	10	Total
Responsibility:											
A. Data collection	x		x	x							3
B. Analysis	x	x			x			x			4
C. Planning and Management	x	x			x						3
D. Policy	x				x	x			x		4
E. Research	x		x	x			x	x		x	6

*See list of respondents in Appendix VII.

2. Computer Literacy in General. Of the 10 respondents, 2 rated themselves as novices (learning applications), 3 rated themselves as intermediate (proficient in applications) and 5 considered themselves to be advanced users (able to configure software and configure macros). Of the group the 6 researchers and 1 system analyst all rated themselves as intermediate to advanced. Generally it is the policy makers and resource analysts and managers that have the lowest overall computer literacy.

3. Current Access to Hardware and Software. Hardware access and needs. All respondents reported access to variety of mini-computers and personal computers (question 6). Among these are VAX and Data General mini-computers, Cyber, Unisys, a variety of IBM clones, and Apple computers. On the question of equipment needed to enhance current capabilities (question 7), most respondents expressed a need for high quality graphics output including a variety of printers, plotters, digitizers, video image capture, laser printers and associated software. This was generally corroborated by the responses in question 4 regarding output devices. In addition needs for networking, image processing, and data base management were also listed. An important issue related to access to hardware and software is the degree to which these facilities can be shared. It is clear that there are economies of scale involved if users can share expensive output devices such as plotters and laser printers. One of the key challenges of the IFP project relate to the geographic remoteness of many of the key players in the project. Research scientists on the project are located in Ft. Collins, Colorado, Tucson, Arizona, and Chicago, Illinois. Foresters and analysts involved in the project are found in Santa Fe, Albuquerque, and Jemez Springs, New Mexico.

Software use patterns and needs. On the question of current use of software (question 8) respondents listed a broad range of software for routine use including wordprocessing, spreadsheets, statistical packages, graphics, database management, GIS and integrated packages. Software used on a special or irregular basis (question 8b) includes customized software for research applications (tree ring, ecological analysis), programming languages, communications packages, computer graphics packages for publication quality report graphics, and GIS.

Technical support. On the question of software customization (question 10), most agency (USFS) respondents felt that the work should be contracted out while the independent researchers felt that the work should be in-house. Regarding in-house technical support (question 11), responses varied with location, but the overall response was that additional technical support was needed and that current access to such help is either lacking completely or too limited.

4. Statistical Literacy. Once again the research oriented respondents (7 of the 10) reported an intermediate to advanced level of literacy in the area of statistics (question 10). The

managers and policy makers reported no literacy in the area of statistics. Those using statistics as part of the work all reported satisfaction with current statistical packages. The important point is that most researchers have found a combination of packages (either commercial or custom) that do the job. It would be unproductive to suggest a standardized package given the variety of research requirements reported.

5. GIS Literacy. In contrast to the questions on statistical literacy, the question on GIS literacy (question 16) shows that half (5) of the respondents have no working experience with GIS, 2 consider themselves novices and only 3 indicate intermediate to advanced proficiency in GIS. It is clear that GIS training and user friendly interfaces will be important in the implementation of any GIS for the IFP project.

B. Conclusions

The results of the survey on user needs points to some clear implications for the specification of a GIS. First, the broad range of interests and applications in GIS require a system or systems that are flexible, powerful and open ended, while being well documented, user friendly, with user support and training available for the participants who need assistance. The low level of literacy among participants in the project suggests that special efforts need to be made in the orientation and training of staff. GIS systems are a sophisticated, complex computer application that requires an appropriate level of understanding to put it to productive use. Second, because of the geographic distribution of the players in the IFP project, it may be impractical for all participants to have direct on-line access to a centralized data base. Particularly in the case of researchers, it may be advantageous to go with stand-alone systems which are compatible with a centralized GIS system that will allow prototyping of models while having the ability to use the data sets available on a central system. Third, is the question of whether or not managers should have hands on interactive access to GIS systems given that this group has the lowest overall literacy of those surveyed. A decision should be made regarding to what extent it is valuable or necessary that these groups have direct access to complex information systems. Thought should be given to the types of standard reports and analyses that managers and policy makers need that may be produced by a technical assistant who actually operates the information system. The alternative is an intensive program of training, with careful thought to the management/policy interface programs which provide access to the spatial information system.

III. DATA REQUIREMENTS

A. Existing Data Sources

Appendix VI. summarizes the data sources that were obtained during personal interviews in Albuquerque and the Jemez District and from information obtained in section 2 of the user survey.

B. Implications for Systems Specification

The IFP demonstration area on the Jemez Ranger District is a relatively small area, by GIS standards, comprising approximately 9,890 acres of the East Fork of the Jemez and Banco Bonito. (See study area description in Appendix III). This suggests that a number of smaller (and less expensive) GIS systems may be used for the demonstration. Much of the data is not currently in digital form and some themes are updated regularly. Importance should be placed on efficient data entry systems for the GIS. Much of the data in the above list is of unknown or questionable quality and accuracy. Data entry costs often comprise 50% of the cost of GIS implementation. Reports by Forrester and Vanderwall (1987) point to the importance of intensive review of data priorities, needs and accuracies before the data entry begins. This is especially true in the context of a research project such as the IFP demonstration where data accuracies may have profound implications on the results of the research. The effect of inaccuracies in base data maps accumulate as these data layers are combined or 'overlayed' in the GIS modelling process. A through review of the purposes and analysis procedures for manipulating map data should be undertaken to examine the consequences of different data accuracies.

IV. GIS FUNCTIONAL REQUIREMENTS

Of the respondents who answered the survey, six responded to the detailed inventory of GIS functional capabilities. The results are summarized below:

A. Input/Editting Generally speaking respondents placed strong emphasis on flexible input and editting capabilities with high priority on quality control and automated editting features.

B. Data Management Manipulation and Analysis Respondents placed high priority on flexibility in quering the data base (via data base functions and direct graphic queries as well as flexibility in transferring data formats from vector to raster and visa versa. Analytics were uniformly rated highly with preference to a wide range of analytical functions.

C. Output Output and display functions were also seen as important with emphasis on powerful display manipulations such as 3-dimensional representation of the data with flexible editting and high quality graphic production a priority.

As might be expected the research scientists want the best system they can get their hands on, with the fullest range of capabilities available. This can be expected and in a research environment these concerns should be taken seriously since it is impossible to anticipate the whole range of needs for analysis and display in a research environment.

V. INSTITUTIONAL FRAMEWORK

The specifications for the GIS system for the IFP demonstration project must give reference to the institutional framework within which the project will be implemented. This section discusses some of the implications arising from the duo-purpose nature of the GIS system (viz. research and management/policy functions). Because GIS in the USFS is a national initiative a discussion of the relationship of the current effort to the National GIS plan is reviewed.

A. Relationship to National GIS plan.

This section provides a summary of current Forest Service policy (USDA Forest Service, 1988) relating to the implementation of geographic information systems as stated by the Forest Service National GIS Steering Committee. It serves to demonstrate the role of the GIS Needs Assessment for the Integrated Forest Protection Demonstration Area within current Forest Service GIS policies.

The current policy of the Forest Service with reguard to geographic information systems is the creation of a series of forest level digital geographic data bases. The creation of these data bases and their use in GIS involves a multi-step process of integration of information needs, data types, workload, and information products. The first step in this process is the description of functional requirements and workload estimates for the purposes of natural resource management on Forest Service lands. Description of functional requirements begins with a careful identification of information needs. Information here refers to two types, basic and management. Workload refers to the conversion of basic (research) data into management (planning) data. Both types of information are identified by reviewing the various responsibilities of all personnel involved in the creation and utilization of data bases at the forest level. This information is translated into specific information products required for research or management purposes. Such information products are used to identify specific data requirements. In turn, data processing functions can be concisely identified for the required information products. In this way, information requirements are driving both data needs and the technology that may be utilized to process such data.

The GIS Needs Assessment for the Integrated Forest Protection Demonstration Area works within the framework of current Forest Service policy for implementation of geographic information systems. The needs assessment has identified the research and management objectives and responsibilities of all potential GIS users involved in the IFPDA. The information needs for research and management have been identified and analyzed in a manner that is in accordance with Forest Service policy. All required output products, their quality, and frequency of use have been identified. An inventory of data has been compiled from a survey of information needs with respect to data type, form, date, and utility. In addition, the GIS Needs Assessment provides a pro-

file of potential users' literacy with respect to computer systems, statistics, and geographic information systems.

B. Research Environment

The current research is directed from the Rocky Mountain Forest and Range Experiment Station in Fort Collins, Colorado. Current discussions are underway for cooperation with the North Central Forest Experiment station in Chicago on landscape and recreation research. Research Scientists associated with the project are located in Fort Collins and Tucson.

All research scientists at the University of Arizona have access to 80286 or 80386 personal computers with the capabilities for powerful desk top applications. Scientists at Fort Collins, responding to the survey, generally have access to a variety of micro and mini computers (Cyber, Data General, Unisys). Most personal computer systems would need to be upgraded to support GIS functions primarily through expanded hard disk storage and improved graphics. Computer communications between University of Arizona researchers and Fort Collins and USFS personnel in New Mexico currently do not exist.

C. Forest Management Environment

Forest managers, policy makers and resource specialists are located in Albequerque, Jemez Springs, and Santa Fe, New Mexico. Data collection and data entry occurs primarily at the district level. Maps and records are often stored either at the SO in Santa Fe or at the RO in Albuquerque. Ft. Collins RMS also stores forest data. Consolidating this information into a GIS data base will require careful coordination among the various groups. An in-house GIS coordinator should be assigned to oversee data management issues.

Much of the data is presently not in digital form. In addition, much of the forest data is in the form of aerial photographs which are not corrected for scale. Estimates of the accuracy and resolution of the numerous map themes varies considerably. Careful management of the data entry process in relationship to research and management goals needs to be considered. It may be necessary in some cases to recollect the field data in order to obtain maps of appropriate levels of accuracy for the purposes of research. In a long term sense, procedures for data collection and mapping should be reviewed and updated to ensure adequate levels of mapping accuracy and horizontal control.

Training will be important for everyone from data entry technicians to policy makers. Customized interfaces may be necessary for different users to ease the learning curve and boosting productivity. Time and resources will need to be allocated to allow for transition to the computing environment and GIS.

VI. CONCLUSIONS OF NEEDS ANALYSIS - GIS SPECIFICATIONS

The results user needs analysis and the data inventory have strong implications on the GIS systems specification:

1. Researchers in the demonstration project have needs for high level analysis with the ability to integrate current research tools (statistical packages, spreadsheets, and database management systems) with the GIS packages. Most of these people have existing hardware and software (primarily IBM compatible personal computers) which should be a consideration in deciding on any GIS system in terms of system environment compatibility and/or data format and communications compatibility. Researchers tend to be computer literate, though few have literacy in the area of GIS. Training in the areas of GIS literacy, spatial analysis and modelling and GIS data structures would be appropriate for this group.

2. Resource specialists, forest policy makers, and management personnel have special needs for training and ease of use. Training should be specific for each group (data entry systems for technicians, resource modelling and analysis for resource specialists, and decision making methodologies for decision makers and policy makers.

3. The computing environment is diverse. Some of the researchers on the project do not have access to the Data General communication system. Many parties are on stand alone personal computers. Not all parties have the same needs for analysis, though high quality graphic output requirements are universal.

4. The computing environment is dispersed. As was discussed earlier, the participants in the demonstration project are dispersed in three states. This puts severe limitations on systems configurations that presume close proximity among users.

5. The study area is small, though complex. This fact alone, lends the greatest opportunities and flexibility in terms of systems configuration. The advantages of a small study area are numerous. Lower data entry costs, faster time to production, smaller mass storage device requirements, and smaller (and less expensive) systems in general are some of the key advantages of a small study site. These factors can factor significantly in the successful implementation of a GIS for the demonstration project. The advantages of a small study however do not discount the need for GIS since the study area is complex, with many conflicting management issues. The combination of small size and complexity are two factors that make the study area ideal for demonstrating the usefulness of GIS for the Jemez demonstration project.

6. Though the current demonstration is a small study area, concern should be given to the long term needs of the Santa Fe National Forest in terms of spatial information systems. This suggests the need for upward compatibility with high level

environments should a small systems approach be taken for this project.

A. Systems configurations

Given the unique circumstances of the IFP demonstration area and the needs of people involved in the project several options are open which can satisfy the GIS needs for the project. The following configurations are presented in order of price and performance, starting with the low-end systems.

SINGLE USER
PC-BASED STAND-ALONE DESK TOP GIS SYSTEMS

Option 1: PC-Based Raster Analysis Package

In this option emphasis is placed on utilizing existing hardware available to participants in the IFP demonstration. Low-end workstations should be upgraded to support math co-processors, EGA graphics, and 8 to 12 mhz 80286 chips with at least 1 megabyte of RAM and 40 megabytes of hard disk storage. The configuration described here utilizes existing software along with some custom programming to interface the packages for high quality analysis and graphics. The same workstations would be duplicated for each researcher, in the district office, and in the Supervisor's office and the Regional office.

System Environment:

Hardware
- IBM compatible 80286 AT or PS/2 model 50,60,70 or 80
- 80287 math co-processor
- 40-120 meg hard disk or 20x20 Bernoulli Box
- EGA or VGA graphics
- Mouse or Graphics Tablet (24" x 36" or 36" x 48" for digitizing workstations, 12"x12" for other stations)
- Graphic Printer
- 11"x17" plotter for research workstations
- 'D' size plotter for district level workstations

Software
- DOS 3.3
- IDRISI - raster based GIS system
- AutoCAD - CAD software for digitizing and output graphics
- Paint program for color screen or slide graphics
- DBASE III - Data Base Management Software
- Custom interface software

Approximate costs:

Hardware: $5,000-$12,000 per workstation depending on power, speed and peripheral devices, less to retrofit existing PC workstations.

Software: $3,000 per workstation.

Advantages:

1. immediately accessable to all parties in the IFP demonstration
2. compatible with existing PC software (especially statistical packages and word processing).
3. inexpensive and fast to implement
4. good spatial analytics for research
5. complete compatibility between workstations

Disadvantages:

1. the learning curve is much steeper because the user has to learn several different packages and not just one
2. Poor software integration.
3. Poor user support.
4. Poor upgrade path
5. Limited data structure (raster only)

Option 2: PC-BASED Vector and Raster Analysis system

This option maintains the philosophy of desk-top PC's presented in option 1. However the major difference in this option lies with the emphasis on a commercially developed, integrated package with both vector and raster analysis capabilities. Again this configuration would be duplicated for each user.

Hardware configuration:

Same as Option 1.

Software:

DOS 3.3
PC-Arc Info (complete package)

Approximate Costs

Hardware: $5,000-$12,000 per workstation depending on power, speed and peripheral devices, less to retrofit existing PC workstations.

Software: $8,000 per workstation.

Advantages:

1. immediately accessable to all parties in the IFP demonstration
2. compatible with existing PC software (especially statistical packages and word processing).
3. inexpensive and fast to implement
4. good spatial analytics for research
5. both vector and raster data structures

6. Good upgrade path to workstation, mini and mainframe versions of the package since PC can be used as terminal to larger systems.
7. Good user support
8. Device independent (VDI) graphics support a large number of graphics devices.
9. Software available as modules
10. Good links to ERDAS image processing

Disadvantages:

1. Steep learning curve
2. Inadequate training available for current PC-Arc Info package (Video tapes and manuals only).
3. Expensive software solution given number of workstations required.

MULTI-USER WORKSTATIONS FOR EACH MAJOR LOCATION

Option 3: Multi-user workstations at each major location

In this configuration, multi-user workstations are provided at each major location (Fort Collins, University of Arizona, Jemez, Santa Fe, and Albuquerque). Cost varies according to the number of users sharing the system. The configuration suggested here is based on the UNIX operating system with high quality graphics terminals or PC's with EGA graphics and Tektronix terminal emulator software.

System Environment:

Hardware
- SUN 3/60, Tektronix, IBM RT, Apollo, or Micro-VAX
- High resolution color graphics terminal for each workstation or PC's with EGA and Tektronix terminal emulation.
- 120 MB disk
- math co-processor
- tape backup
- Ethernet
- Mouse or Graphics Tablet (24" x 36" or 36" x 48" for digitizing workstations, 12"x12" for other stations)
- Graphic Printer
- 11"x17" plotter for research workstations
- 'D' size plotter for district level workstations

Software
- UNIX operating system
- Arc-Info

Approximate costs:

Hardware: $21,000 - $40,000 per workstation depending on power, speed and peripheral devices, less to retrofit existing PC workstations.

Software: $24,000 per workstation.

Advantages:

1. immediately accessable to all parties in the IFP demonstration
2. compatible with existing PC software (especially statistical packages and word processing).
3. good spatial analytics for research
4. complete compatibility between workstations
5. Excellent upgrade path

Disadvantages:

1. More expensive solution
2. Operating system incompatible with existing systems
3. Existing software becomes obsolete or 'orphaned' unless PC's are used as terminals with good communications packages.
4. User's must either be in close proximity to system or have access to ethernet network.

Option 4: Multi-user workstations for District Forest Staff, PC-workstations for research staff.

In this option a combination of options 2 and 3 is suggested. The rationale behind this solution is to reduce the equipment costs for university and research staff in Fort Collins without sacrificing analytical capabilities. Compatibility is maintained as is an adequate upgrade path. This option is not detailed since the configurations are identical to those described in options 2 and 3 above.

PUBLIC DOMAIN SOFTWARE ON EXISTING MINI-COMPUTERS

Option 5: Install public domain software such as MOSS, SAGIS, or GRASS on existing systems.

This option, while attractive from an economic point of view is probably the worst from the user point of view. MOSS has poor analytical capability, poor links to databases and is not currently supported by the Forest Service. BLM is currently supporting MOSS, but the Denver Service Center is over-extended and could not be depended on to support forest service users without an agreement. AUTOMETRICS in Ft. Collins also supports MOSS on a contract basis. This support is probably well worth the cost given the complexity of the package. MOSS does not support topologically structured vector data and has incomplete raster analysis routines. The advantages of MOSS are that it is already installed at the University of Arizona and source code is available. However, the disadvantages of the package far outweigh the advantages.

SAGIS which is developed and supported by the National Park Service. NPS has current efforts underway to link the vector based SAGIS to GRASS (Army Corp of Engineers). The combination of SAGIS and GRASS shows some promise in terms of analytics. However both packages are currently under development on UNIX based systems. GRASS, in particular, is difficult to transport from systems other than MASSCOMP and SUN workstations. User support and training on both of these packages is lacking.

Considerable in-house expertise would be required to load and maintain public domain packages. Of the two options presented above, the SAGIS/GRASS combination is probably the most promising, however considerable research should be undertaken to determine the feasibility of maintaining these packages. In general, if in-house expertise is not available or cannot be acquired, it is better to avoid public domain software.

B. RECOMMENDATIONS

Of the options presented above. The preferred solution, would be option 2 or 3. Either solution would serve the purposes of the IFP demonstration. If budgets for these options are not available, option 1 would serve the purpose of the demonstration. Even though the learning curve is steeper on this option, the PC software is generally well documented and with good user-support. Since many of the key players in the IFP demonstration are already using PC's this may actually be the fastest option to implement as well as the least expensive. The more complex the system configuration, the greater the need for technical staff to assist in the operation and maintenance of the software. Training and support are essential in the successful implementation of any new technology. Because of this, commercial packages like ARC-INFO, though more expensive initially, are probably economical choices in the long term.

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APPENDIX I

GLOSSARY OF TERMS

ALPHANUMERIC[3]	(Alphabetic/Numeric) Pertaining to a character set containing letters, digits, and special characters and symbols. Synonomous with alphameric.
ANALYSIS[3]	Performing computations on previously obtain data.
ARC[3]	Lines used to represent the location linear features or the borders of polygon features. Arcs may be topologically linked to the nodes at each end of the arc and to the polygons at each side of the arc. In addition, an arch attribute may be created, defining for each arc a value for a set of thematic variables (ie. type of stream, length, etc.)
ASPECT ANALYSIS[3]	An analysis which calculates from topographic elevation the direction of the steepest downward slope for each grid cell.
ASCII[2]	American Standard Code for Information Interchange. Standard code for representing alphabetic characters, digits, and symbols by bits in a computer. All major computer manufacturers in the United States and in many other countries have agreed on this convention, but IBM, the largest, also uses its own system, EBCDIC.
ATTRIBUTE[3]	A characteristic of a site or phenomenon.
BACKUP[3]	Duplicate data files, redundant equipment or procedures used in the event of failure of a component or storage media.
BASIC[3]	Beginner's All-purpose Symbolic Instruction Code. An easy-to-learn high level language most frequently used with minicomputers.
BASE MAP[3]	The standard map to which all other data is rectified during a geographic study. Data is encoded or digitized from the base map to create a geographic data file.

BATCH PROCESSING[3]	A control technique for grouping similar output items for handling during the same run. A process whereby a user submitted job enters into a prioritized "hold" queue(s) along with other user submitted jobs, for systematic execution. Action ordinarily not available at the time of request. An alternative to interactive or on-line processing.
BAUD[2]	Measure of signaling speed, often used to describe the rate at which a terminal and computer communicate with each other. In most cases, the number of baud units is the same as the number of bits per second (BPS). The term "baud" is derived from the name of J. M. E. Baudot, French pioneer in telegraphy.
BIT[3]	A unit of information denoted by the presence or absence of a property, such as the existence or lack of existence of an electrical impulse or magnetic field.
BMIF[3]	Base Map Image File. A file containing geographic coordinate location information and standard text and legend information. This file can then be used to produce various types of printer maps.
BOOLEAN LOGIC[3]	Decision logic which uses the operators "and", or, "not". Used in some forms of modeling and programming.

BOUNDARY[3]	The boundary of a coverage defines the minimum and maximum extent of the coverage. The lower left and upper right corner of the extent of the coverage features are used to define the boundary rectangle.
BUFFER[2]	Area of computer memory that temporarily holds data or instructions until a communication channel or device is free.
BYTE[3]	An element of data composed of eight data bits plus a parity bit. It represents one alphabetic or special charactor, two decimal digits, or eight binary bits: the smallest sequence of binary digits which can be handled as a unit.
CAD[2]	Computer Aided Design, often stated CAD/CAM, where CAM is Computer Aided Manufacturing.
CARD IMAGE[3]	The CRT representation of a computer card; usually represented by a line of typed data on the CRT screen.
CARTOGRAPHY[3]	Map and Chart construction.
CELL(GRID) SYSTEM[3]	A scheme for storing data in a computer system in which a square or rectangular grid resembling a checkerboard is superimposed over the area of interest. Data within each square or rectangle may then be aggregated according to the type of information it represents.
CENTROID[3]	The mathematical center of a polygon or other closed area.
CHOROPLETH MAPPING[3]	A type of mapping used to display quantitative and qualitative geographic data associated with polygons or areal units.
CLIPPING[1]	The procedure by which lines or parts of polygons falling outside a window are respecified to terminate at the window's edge.
CODE[3]	A quantative or qualitative label used to identify or represent a feature.

COGO[2]	Special computer language for solving coordinate geometry problems common in surveying and civil engineering.
COLUMNS[3]	A unit of horizontal measure in grid cell methodology. Also used to describe punch card fields. (i.e., card columns).
COMPILER[3]	A program that translates high level computer language into machine understandable codes.
CONTOUR INTERVAL[3]	The vertical distance separating successive contours. The interval remains constant over the entire map; therefore, closely spaced contours represent steep sections of terrain while widely spaced contours represent more gentle terrain.
CONTOUR LINE[3]	An imaginary line on the ground, every point of which is at the same elevation above sea level. Contour lines on a map are the graphic representations of ground contours.
CONTOUR MAPPING[3]	A two-dimensional drawing utilizing contour lines to depict specific values of a three-dimensional surface (e.g., elevation contour map).
CONTROL FILE[3]	A user created file which contains all parameters needed to execute a program.
COORDINATE[3]	A arithmetic definition of a point (synonymous with vertice); the location of a point or set of points with reference to a known point, with measurement primarily occuring in x, y, or row and column notation.
CRT[3]	Cathode Ray Tube. A computer terminal which displays data using a "picture tube".

CUT-FILL ANALYSIS[3]	A type of map analysis which uses before and after elevations to calculate qualitative and quantitative cut or fill areas for use in evaluating grading plans. Cut-Fill Analysis uses special options built into the GRID program to list cut and fill amounts for each grid cell arranged by row and column.
DATA[3]	A general term for information. Facts, measurements, classification or value representations from which conclusions can be inferred.
DATA BASE[3]	A collection of logically related files containing both data and structual information. Pointers cross index and allow access to data.
DATA BASE MANAGEMENT SYSTEM[3]	A process that provides methods for creating, maintaining, and using a data base.
DATA CATEGORY[3]	A major type of data which can normally be classified into mutually exclusive sub-categories and represented as a single map; also called a "variable" or "data plane."
DATA COLLECTION POINT[3]	A geographic point at which information applicable to a surrounding area is gathered, ie. a weather station.
DATA COLLECTION ZONE[3]	An area from which representative information is compiled, ie. a census tract.
DEBUG[3]	The process of finding and correcting errors in computer programs.
DEDICATED LINE[3]	A communication line (link between a terminal and a computer) that is dedicated to a single terminal as opposed to a dial-up line.
DEFAULT[1]	An option value or parameter assigned by a system which is open for change by th user if given as a parameter or selected as an option.

DEM TAPES[3]	USGS Digital Elevation Model Tapes available at 1:250,000 scale (a limited number of 1:62,500 scale and 7 1/2 minute quadrangle tapes are available and accurate to within 30 meters.
DIAL-UP LINE[3]	A line that is given to the first terminal that dials into the computer as opposed to the dedicated line.
DIGITAL DATA[3]	Discrete (non-continuous) information expressed using numbers that are digits to represent all the variables involved in calculation.
DIGITIZE[3]	To convert (encode) polygon, line, or point locations into numeric x,y location data files. Sometimes the term is used to mean the transformation of data into numeric representations.
DIGITIZER[3]	A machine which records map locations as x, y coordinate values from an origin. Also, a person who operates such a machine.
DIGITIZER FILE[3]	A file automated using a digitizer, and containing coordinates and topological information.
DIME (FILE)[3]	Dual Independent Map Encoding (file structure used by the U.S. Bureau of the Census).
DMA TAPES[3]	Defense Mapping Agency tapes of elevation data. Available at 1:250,000 scale (covers one degree of latitude, 1/2 degree of longitude; accurate to within 200 feet).
DOUBLE DIGITIZING[3]	A data automation method whereby polygons are digitized in total, thus adjacent polygon boundaries are automated twice.
DOWNLOAD[1]	Transfer computer programs or data from one computer system to another (usually smaller) computer system.
DTM[2]	Digital Terrain Model, representation of topography by a set of numerical elevations, normally in a grid or matrix.

ENCODING[3]	The manner in which data is numerically represented in order to permit computer storage and analysis; preparing a routine in machine language.
ENTITY[1]	A basic unit of data, consisting of values for attributes corresponding to a single case, observation or record.
EXPOSURE ANALYSIS[3]	A mapping analysis which uses topographic elevation and user defined observation points to determine the relative visibility, or surface exposure, of a study area. This analysis is also referred to as a viewshed analysis.
FIELD[3]	A reserved area of a record, card image, etc., used to input control parameters into a program. A field may consist of one or more columns. In FORTRAN, I and F notation parameters are right-justified in a field; A notation parameters are left-justified.
FILE[3]	A collection of records, each of which can be referenced according to it's position in the file.
FLAG[3]	A parameter used to indicate an on/off type of action.
FLAG POINT[3]	A single character (alpha or numeric) designation placed within a multi-character grid cell, often used as a cross reference identification for the value of a variable's category of codes.
FLOATING POINT[3]	An automatic method of determing the location of the decimal point in values.
FORTRAN[3]	FORmula TRANslation a scientifically oriented computer language used for mostly scientific or research applications.
FUZZY TOLERANCE[3]	The fuzzy tolerance is the minimum distance separating arcs in a coordinate coverage. The fuzzy tolerance is used to "snap" arc

	coordinates together when they are within this distance of each other. The fuzzy tolerance should be specified in map units. For instance, on a 1:500,000 scale map, if it is desired that arc coordinates within .002 of an inch should be brought together, and the coverage units are meters, a fuzzy tolerance of 25.4 should be used. 25.4 is the number of meters in .002 of an inch at 1:500,000 scale. It is important to realize that when arc coordinates are "snapped" together, the resulting coordinate point is placed halfway between the two original coordinates.
GEOCODING[2]	Coding information with a spatial reference such as coordinates or street address.
GIS[3]	Geographic Information System. An information system that can input, manipulate, and analyze geographically referenced data in order to support the decision making processes of an organization.
GRID[1]	A data structure in which data elements are stored as a matrix and location is implicity determined by the matrix indexes.
HARDWARE[3]	Computer and peripheral machinery.
HOLE[1]	A region within a map which is topologically outside the map, i.e. it has no data value associated with it, or is enclosed by only one neighbor.
IDENTIFIER[3]	A "code label" or "value" (usually numerical) used to represent or identify a point, line, or polygon. The identifier may be a unique label (ie. sequence number) or it may be a descriptive value (ie. code for a land use category).

IDS[3]	Interactive Digitizing System. Allows interactive data editing during automation.
IMAGE[3]	A representation of a real feature. (Photographic image, digital image, card image, etc.)
IMPORTANCE[3]	The relative measure of consideration assigned to a data category with reference to all other categories included in a planning evaluation.
INPUT[3]	The process of entering an information into a computer.
INTEGER[3]	A representation of a numeric charactor as a whole number, without a decimal point. (83 is an integer, 8.3 is not).
INTERACTIVE GRAPHICS[3]	A process of graphic display which allows interactive (Real Time) graphic manipulation (ie., editing, cosmetic changes, etc.).
INTERACTIVE PROCESSING[3]	A process of user/computer interactive "Real Time" communication and job execution (same as "on-line processing"; action available at the time of request; an alternative to "batch processing".
INTERFACE[3]	The junction between the components of an information system.
INTERPRETIVE DATA[3]	Data that has been related in context to a specific issue or need, usually an abstraction or simplification of data, hence smaller in volume than the basic data used in the interpretation. Data derived (interpreted) from data elements. Includes second level interpretive data (data derived from interpreted data).
ITUM[3]	Integrated Terrain Unit Mapping. Mapping areas which are homogeneous for a known group of attributes.
K[2]	The quantity 1024, although K is sometimes loosely used to mean 1000. Computer memory is commonly described with the letter K, for example, a 64K RAM chip.

KNOTS[3]	Knots are small polygons which share a common node with other line, point, or polygon features. They can be removed using MNODE with the KNOTS option.
LABEL POINT (POINT)[3]	Label points are used to represent point features in ARC/INFO. The point coverage will contain: a) Topology for the points. b) A Point Attribute Table (PAT) which contains attributes for the point coverage. c) An ARC file for that point coverage with coordinates for the point.
LAND COVER[3]	Cultural objects and natural and cultivated vegetation occupying the landscape that can be grouped or classified and subsequently mapped using remote sensing imagery.
LANDSAT[3]	A family of satellites used for remote sensing of the earth's resources.
LCGU[1]	Least common geographic unit - set of polygons resulting from the intersection of all regions within an information system.
LEFT JUSTIFY[3]	To place the left-most significant character of a data string in the left-most position of a field.
LEVEL[3]	A sub-category of data, such as a sub-set of soil codes within the overall category "soil".
LINE[3]	An arc or a set of arcs defining a line feature that is either too narrow to be represented by a polygon, (ie. a road), or is an imaginary line that has no width (ie. section lines in a township and range coverage, contour lines, etc.).

LOOKUP TABLE[3]	A lookup table is used to create categories for a coverage .PAT or .AAT file and to store a code value to be associated with each of the item categories. The .PAT or .AAT file must contain an item which is defined identically to the corresponding item in the lookup table. The lookup table must also have some values which correspond to the values of the items in the .PAT or .AAT files.
MAGNETIC TAPE[3]	A mass storage device that uses reels of magnetic tape much like the tape used in tape recorders. Mag tape usually refers to a specific 3/4 inch reel tape as opposed to cassette tape.
MAIN FRAME[3]	An informal term for the central processing unit of a computer equipment system.
MANUSCRIPT MAP[3]	Hand drafted map (ie. from photo interpretation) normally used to digitize data.
MATCH TOLERANCE[3]	The MATCH TOLERANCE is the minimum distance separating nodes in the output coverage. It should be specified in coverage units. (ie., if nodes within .002 of an inch of each other need to be snapped together on a 1:500,000 scale map which has coordinates in meters, a MATCH TOLERANCE of 25.4 should be used). If nodes fall within the MATCH distance specified, then they are "snapped" together to produce a new common node halfway between the distance of the original nodes.
MEGABYTE[2]	A million bytes. Often used to refer to the storage capacity of hard disks.
MENU[2]	List of choices presented to the user on a CRT screen. Particularly "programs user-friendly" use menus a great deal and are often described as "menu-driven."

MODEM[3]	A device attached between a computer device and a phone line that translates in either direction depending on the circumstances. MODulate-DEModulate.
MODEL[3]	A predictive surrogate of real characteristics and dynamics. A mathematical representation of some activity or process.
MODULE[3]	A sub-area. Used for mapping an area and automating data.
MULTI-VARIABLE FILE[3]	For GRID, a file that contains the data froion on LANDSAT imagery. One picture element on LANDSATs 1,2 corresponds to an area 57 by 79 meters on the ground.
PLANIMETRIC[3]	Measurement of an irregular surface on a two-dimensional plane.
PLOTTER[3]	Device controlled by the computer that moves a pen over a paper on a drum or flat surface.
POLYGON[3]	A polygon is a closed plane figure bounded by line segments that enclose a homogeneous area (ie. a state, lake, or census tract). Normally, several polygons are adjacent to one another and share borders with other polygons.
PROCEDURE[3]	A precise step-by-step method for handling data or for solving a problem; a series of programs linked together to accomplish a specific task.
PROGRAM[3]	More commonly referred to as a "computer program"; the complete plan for the solution of a problem. Specifically, the complete sequence of computer instructions necessary to solve a problem.
PROJECTION[3]	One of several methods which represent a spherical object (the earth's surface) on a flat plane (a map).
PROXIMAL MAPPING[3]	A method whereby non-continuous data is mapped using data from a single point to generate an areal surface.

PUBLIC LAND SURVEY[3] SYSTEM	Public lands are subdivided by a rectangular system of surveys established and regulated by the Bureau of Land Management. The standard format for subdivision is by townships measuring 6 miles on a side. Townships are further divided into 36 numbered sections of 1 square mile (640 acres) each.
QUADRANGLE[3]	Four-sided area, bounded by parallels of latitude and meridians of longitude, used as an area unit in mapping (dimensions are not necessarily the same in both directions).
QUALITATIVE[3]	An abstract characterization of data that describes "what type" (ie. soils, vegetation, land use etc.).
QUANTITATIVE[3]	A characterization of data that describes "how much".
RAM[3]	Random Access Memory. The portion of computer memory generally available to execute programs and store data. Memory locations can both be read from and written to at high speeds.
RASTER[2]	Conventional television-type displays on CRTs. The alternative and much less common display is the DVST.
REAL TIME[3]	The technique of coordinating data processing with external related physical events on a timely basis, thereby reporting on conditions promptly. Action immediately taken.
RECORD[3]	A collection of related items of data stored and treated as a single unit.
REMOTE SENSING[3]	Gathering information from a distance.
REPORT[3]	A tabular representation or product produced by the computer, usually output to a line printer, and displaying data in an organized and readable form.
RIGHT-JUSTIFY[3]	To place the right-most significant character of a data string in the right-most position of a field.

ROM[3]	Read Only Memory. A portion of computer memory where information is permanently stored. This information can be read at high speed but can never be altered. It is not available to execute programs or store data.
SCALE[3]	The ratio of a distance on a photograph or map to it's corresponding distance on the ground. Scale may be expressed as a ratio, 1:24,000, a representative fraction, 1/24,000, or an equivalence, 1 inch = 2,000 feet. The first two can be interpreted a 1 unit of measurement on map or photo is equal to 24,000 units of measurement on the earth's surface, regardless of the unit.
SEARCH ANALYSIS[3]	Investigating the area around a feature using either of the two types of search operations. One type defines the minimum distance from each grid cell to one or more data types designated by the user. The other search operation determines the frequency of occurrence of one or more data types within a specified search radius of each grid cell.
SLOPE ANALYSIS[3]	An analysis which uses topographic elevation to calculate the slope gradient of each cell, in percent slope.
SINGLE VARIABLE FILE[3]	A file containing the data for one variable (one layer).
SOFTWARE[3]	Computer programs.
SPATIAL[3]	Refers to the location of, proximity to, or orientation of objects with respect to one another.
SPATIAL DATA[3]	Facts about an area organized geographically.
SPOOLING[2]	Performing printing or other output operations while other programs are being developed or running. This is called "spooling" the output, and the program that does it is called a "spooler."

STATE PLANE COORDINATES[3]	Coordinate systems, one for each state, established by the U.S. Coast and Geodetic Survey, for use in defining positions of geodetic stations in terms of plane rectangular (x,y,) coordinates.
SUN INTENSITY ANALYSIS[3]	A mapping analysis which uses topographic elevation, latitude, time of year, and time of day to calculate the sunstream angle for each grid cell within a study area.
SYSTEM[3]	A combination of a number of processes to handle and/or retain data; a configuration of equipment which comprises a group.
TELECOMMUNICATIONS[3]	Transmission of data over long distance phone lines, microwave, etc.
TERMINAL[3]	A device used to enter information into the computer system and/or retrieve information from it. With many systems this would refer to the CRT but may also be a printing terminal.
TIC MARK[3]	A reference point for which coordinates in one of seveal systems (ie. State Plane, UTM, etc.) are known. May be used to redefine all other digitized inch coordinate locations on a manuscript map into the other coordinate system.
TOPOGRAPHY[3]	Representation of the surface features of a region, including hills, valleys, rivers, lakes, canals, bridges, roads, cities, etc.
TOPO PLOT[3]	A plotter media display of gridded data showing contour or isolines. Used for continuous surface type data.
UTILITY[1]	A program or function performing tasks which are useful to other parts of a system.
UTM[3]	Universal Transverse Mercator. Coordinate referencing system based on a global grid. Used throughout the world except in polar regions.

VALUE[3]	A code; the numerical representation of an attribute.
VARIABLE[3]	A geographical phenomenon for which the value changes over distance. (For example, topography, soil). Synonymous with data plane, data category.
VECTOR[1]	Data structure in which primitive elements are points and line segments. Any two points in space can be linked, regardless of the direction of the segment.
VIEWS[3]	A 360' three-dimensional visual display from a point of observation, using CRT or plotter display drawing of gridded data, usually topographic elevation. Sometimes called three dimensional views.
WATERSHED ANALYSIS[3]	The study of areas characterized by water draining to a water course or body of water. Includes runoff and flood level calculation, flood damage estimates, pollution levels etc.
WINDOW[3]	Sub-area. Used for analysis.
X-AXIS[3]	A horizontal axis in a system of rectangular coordinates. That line on which distances to the right or left (east or west) of the reference line are marked, especially on a map, chart, or graph.
X-Y COORDINATE DATA[3]	Data digitized by recording Cartesian coordinates which define points, lines, or polygons.
Y-AXIS[3]	A vertical axis in a system of rectangular coordinates. That line on which distances above or below (north or south) of the reference line are marked, especially on a chart or graph.

ZOOMING[1]	Operation in which a sub-image is specified (usually a rectangle, specified by the x and y values of the lower left and upper right corners) and redrawn at the size of the display device.

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[1]Clarke, Keith C. 1983. "Research on the Uses of Geographic Information Systems and Remote Sensing for Program Applications of the USDA Soil Conservation Service, NASA.

[2]MacDougall, E. Bruce. 1983. Microcomputers in Landscape Architecture. Elsevier; New York. 267 p.

[3]State of Utah, Automated Geographic Reference Task Force. 1984. "Geographic Information Systems Glossary of Terms."

APPENDIX II

4-25-88

To: Participants in Integrated Forest Protection Demonstration Area, Jemez Ranger District, Santa Fe National Forest.

Subject: Geographic Information System Needs Assessment Questionnaire

From: Robert M. Itami
University of Arizona

You have been selected to participate in the attached questionaire because of your interest or expertise relating to the Integrated Forest Protection Demonstration Area. The purpose of the questionnaire is to provide information on user needs for geographic information systems in forest resource inventory, assessment, management and research. The survey of user needs is conducted under a cooperative agreement with the University of Arizona.

In addition to the questionnaire, you will find two short documents which will provide background information on the purpose of the IFP demonstration and the role of GIS in modelling the spatial aspects of pest assessment.

Please complete the questionnaire and return it in the envelope provided by May 9, 1988. After receiving your questionnaire we may call you to clarify or expand on your responses. Thank you for your cooperation. If you have any questions, please feel free to call:

Robert Itami
School of Renewable Natural Resources
University of Arizona
BSE 325
Tucson, AZ 85721

(602) 621-5951
621-1004 (messages)

QUESTIONNAIRE FOR
GIS NEEDS ASSESSMENT FOR THE INTEGRATED
FOREST PROTECTION DEMONSTRATION AREA, JEMEZ RANGER DISTRICT,
SANTA FE NATIONAL FOREST.
APRIL 22, 1988

This questionnnaire requests information to determine system specifications of a Geographic Information System for the Integrated Forest Protection Demonstration Area (IFP), Jemez Ranger District, Santa Fe National Forest. It consists of two parts: 1) identification of the requirements of individual users, 2) description of available data.

Please complete the following personal data section to assist us with follow-up interviews.

Name_____

Title_____

Address_____
_____
_____

Phone_____

Please return completed questionnaire to:

Robert Itami
School of Renewable Natural Resources
University of Arizona
BSE 325
Tucson, AZ 85721

Part 1. Identification of User Requirements

This section contains questions about potential users, their present computing system, and the analyses they would like to conduct. Adequate identification of user needs and computing systems are essential for determining which GIS functions are required and what other systems must be interfaced.

1) What is your major interest or responsibility in the IFP area and GIS technology?

2) What are your principle management or research objectives for the IFP area?

3) Please indicate your primary responsibilit(ies)

___A. Primary data collection/recording/mapping.

___B. Analysis and mapping of one or more factors (themes) for the purposes of resource assessment or inventory.

___C. Decision making for management and planning. Synthesizing information from resource specialists for the purpose of developing forest management plans.

___D. Policy making. Establishing long term planning goals and objectives.

___E. Research. Applied or basic research in forest resources.

4) The following table contains a list of output devices that may be required to achieve your management goals or research objectives. For each device that you require indicate output quality, priority, and frequency of use by responding in the appropriate columns of the table. Using the legend below, place the number corresponding to the applicable response in the columns of the devices you require. For example the value for a publication quality text printer would be "1".

Quality	Priority	Frequency of Use
1 publication	1 essential	1 hourly
2 draft	2 high	2 daily
	3 low	3 weekly
	4 not required	4 monthly

Output Device	Quality	Priority	Frequency
Text Printer			
Graphics Printer			
Color Graphics Printer			
Single Pen Plotter	**********	**********	**********
* 11" x 17" format			
* 18" x 24" format			
* 24" x 36" format			
Multiple Pen Plotter	**********	**********	**********
* 11" x 17" format			
* 18" x 24" format			
* 24" x 36" format			
Electrostatic Plotter	**********	**********	**********
* color			
* monochrome			
Color slides			
Color video tape			

5) How would you rate your level of computer literacy? Please check appropriate description.

___ None

___ Novice (learning applications)

___ Intermediate (proficient in applications)

___ Advanced (able to configure software; program macros)

___ Expert (routinely use one or more programming languages)

The following section of Part 1 requests information about hardware and software that may be used in your work. If you responded as a Novice or less in number 5 proceed to Part 2 of this questionnaire.

6) Please list the types of computer hardware that are currently used in your work. If you are knwoledgable about the systems, indicate the CPU, RAM, and disk capacity.

Manufacturer/Series	CPU	RAM	Disk Storage capacity	Storage load	Access*

* For access enter 's' for shared with other users
or 'p' for personal use

7) What facilities or equipment do you feel are needed to enhance your capabilities? Please list in order of priority.

1. _____

2. _____

3. _____

4. _____

5. _____

8) What type(s) of software are you currently using to meet your data processing requirements?

a) on a routine (weekly or monthly) basis

b) on a special or irregular basis

9) Please list in order of priority the types of software packages you wish to acquire for use in your work.

1. _____

2. _____

3. _____

4. _____

5. _____

10) In the event that certain programs need to be customized to meet the needs of your work, would you prefer to do this modification in-house or on a contract basis?

11) What technical support do you have?

a) for data entry and processing

b) for computer programming and systems operation

This section requests information about statistical analysis requirments of your work.

12) Please indicate your level of proficiency with statistical software (e.g. SPSS, SAS, BMPD, SYSTAT, etc.)

___ None

___ Novice (learning elementary functions)

___ Intermediate (routine use of statistical functions)

___ Advanced (design complex statistical analyses)

___ Expert (program statistical analysis procedures using high level programming languages)

13) What types of basic and multivariate statistical functions and analyses are you using in your work (e.g. linear programming, analysis of variance, etc.)

14) Are you satisfied with existing stats packages you are using? If not, list the package(s) you would prefer to use.

This section requests information about the use of Geographic Information Systems in your work.

15) What level of access and interaction with the GIS would you desire to achieve your objectives?

___ None (not needed)

___ Infrequent (once a month or less)

___ Routine (once a week or more)

___ Heavy (use as a primary productivity tool)

16) Please indicate your level of proficiency with GIS.

___ None

___ Awareness (familiar with concept, but not a user)

___ Novice (learning to use GIS operations)

___ Intermediate (routine use of raster and vector operations)

___ Advanced (proficient at modelling and integrating with DBMS)

___ Expert (research and development in spatial analysis systems)

If you responded to number 16 as a Novice or less, proceed to Part 2 of this questionnaire.

The following is a list of GIS functional capabilities. The list is organized by class and component of function. Under each component is a list of specific items of functional capability. For each item in the list, place the appropriate priority value in the space provided, using the legend below.

Priority values for functional table

0 no value 1 high 2 medium 3 low

DATA CAPTURE

DIGITIZING

___ RASTER SCANNING
___ SOUND REGISTRATION
___ ATTRIBUTE ATTACHING
___ VALIDITY CHECKS
___ BATCH ENTRY
___ INTERACTIVE EDITING
___ ENDPOINT SNAPPING
___ USE RANGE OF INPUT DEVICES
___ DATA QUALITY INFORMATION
___ AUTO POLYGON GENERATION

TRANSPORT

___ FORMAT CONVERSION (GIS)
___ DEM INTERFACE
___ COMMUNICATION LINKS

EDITING

___ ON-LINE MODIFICATION
___ SLIVER REMOVAL
___ LABEL ALTERATION
___ ILLEGAL ATTRIBUTE CHECK
___ TABULAR UPDATE
___ RASTER UPDATE

DATA MANAGEMENT

STORAGE

___ FILE SET AS DATA BASE
___ THEMATIC ORGANIZATION
___ SPATIAL ORGANIZATION

UPDATE

___ STATUS REPORTS
___ SELECTIVE ADDITIONS
___ AUTOMATIC DATA INDEX

RETRIEVAL

___ SUPPORT SEQUENTIAL ACCESS
___ SUPPORT SPECIFIC ACCESS
___ FIELD VALUE CALCULATIONS
___ SHARED FIELD RELATION
___ FILE ATTRIBUTE SORTING
___ VARY SORT METHODS

Priority values for functional table

0 no value 1 high 2 medium 3 low

DATA MANIPULATION

REDEFINITION
- ___ AUTO CONCATENATION
- ___ SPATIAL UNIT SELECTION
- ___ DATA LAYER SELECTION
- ___ ATTRIBUTE COMBINATION SELECTION

RESTRUCTURING
- ___ VECTOR/RASTER CONVERSION
- ___ COMPRESS/DECOMPRESS DATA
- ___ INTEGRATE DATA MODELS
- ___ SURFACE DATA FROM POINTS
- ___ COGO/GEOG CONVERSION
- ___ CELL SIZE MODIFICATION

ANALYTICAL TECHNIQUES

OVERLAY
- ___ BOOLEAN OPERATIONS
- ___ OPTIONAL WEIGHTING
- ___ LINE TO POLYGON OVERLAY
- ___ POINT TO POLYGON OVERLAY
- ___ FUZZY DATA HANDLING

NEIGHBORHOOD ANALYSIS
- ___ OPTIMUM ROUTES
- ___ SERVICE SHED MODELLING
- ___ VIEWSHED MODELLING
- ___ ASPECT ANALYSIS
- ___ SLOPE ANALYSIS
- ___ INTERPOLATION

STATISTICS
- ___ AREA/PERIMETER CALCS
- ___ PROBABILITY CALCULATIONS
- ___ OVERLAY AREA CALCULATIONS
- ___ DESCRIPTIVE STATISTICS
- ___ GENERAL STATISTICS
- ___ MULTIVARIATE STATISTICS
- ___ GRAPHIC OUTPUT

DISPLAY

GENERATION
- ___ CREATE FILM TRANSPARENCIES
- ___ 3-D/PERSPECTIVE OUTPUT
- ___ VARIABLE VIEWPOINTS
- ___ HIDDEN LINE REMOVAL
- ___ PROFILE DISPLAY
- ___ GRAPHIC SCALING
- ___ GRAPHIC QUERY FUNCTIONS
- ___ MULTIPLE IMAGE OUTPUT
- ___ HALFTONING CONVERSION
- ___ IMAGE STORAGE FOR REPRO

ANNOTATION
- ___ GRAPHIC ANNOTATION
- ___ DEFINE FONTS/SYMBOLS
- ___ ALPHA/NUMERIC LABELS
- ___ AUTO POLYGON LABELLING
- ___ PLACE SHEET FURNITURE

Part 2. Description of Available Data

This section requests information about spatial and tabular data which would be accessed and processed by the GIS. This information will be used to determine basic data themes, attributes, coverage, resolution, and needed links to other data bases and post-processors. In this context, basic data refers to those raw facts gathered in surveys and used as input for analyses to produce the interpreted information that is used in decision-making.

Attached to this questionnaire you will find a few copies of a DATA INVENTORY FORM, which is to be used to provide information about spatial and tabular data that is used in your work. The instructions for completing the form are as follows:

* DATA TITLE -- provide descriptive title for the data set
* DATA SOURCE -- provide complete reference for source of data
* DATA TYPE -- indicate spatial, tablular, etc.
* DATA FORM -- indicate hardcopy or digital
* DATA LOCATION -- for example "district offce"
* DATA DATE -- date of data capture or update

If the data type is spatial (mapped), please respond in the MAPPED DATA ONLY section of the form as follows:

* EXTENT -- for example "whole district" or specific portion
* SCALE -- eg. 1"=2000' or 1:24000
* RESOLUTION -- comment on the size of the smallest mapped area

If you need additional data inventory forms, please photocopy the forms provided and attach to questionnaire.

DATA INVENTORY FORM

Data Title_____

_____

Data Source_____

_____

Date Type_____

_____

Data Form_____

_____

Data Location_____

_____

Data Date_____

MAPPED DATA ONLY
Extent_____
_____
Scale_____
_____
Resolution_____
_____
_____
_____

How many different categories (data base fields or map attributes) are in this data set?_____

How reliable do you think this data is for your purposes?_____

_____

How essential is this data for your management or research objectives?_____

_____

How useful is this information across a broad range of management or research objectives?_____

_____

APPENDIX III

PURPOSE FOR IFP DEMONSTRATION

The following commentary is extracted from the approved plan for the Integrated Forest Protection Demonstration Area, dated November 25, 1987.

Integrated Forest Protection (IFP)is a management decision-making system which focuses on the forest stand rather than a pest population. IFP planning, decisions, and actions are based on knowledge of the beneficial and detrimental effects of pests on resource values. Forest insects and pathogens are recognized as important components of the functioning of a healthy ecosystem. Therefore, IFP challenges the resource manager to be aware of the interrelation of the pest-host system to the forest ecosystem as a whole. The manager must anticipate pest problems on the target pest, other organisms, and resource values.

The IFP area emcompasses 9,890 acres of the East Fork of the Jemez and Banco Bonito. Major geographic features on or near the area include Jemez Canyon, Los Griegos peak (10,100 ft.), East Fork of the Jemez River, Redondo peak (11,254 ft.), and the Valle Grande caldera. The average elevation is 8,500 feet on the wide sloping bench above the dramatic drop to the East Fork. The area is mostly forested -- 58% ponderosa pine and 21% mixed conifer (Douglas-fir, white fir, blue spruce, aspen, and ponderosa pine); the remaining area is divided into stands of either Douglas-fir, white fir, blue spruce, aspen, or grasses and forbs. Management emphasis on 41% of the area is directed toward enhancement of visual quality and developed recreation while protecting wildlife habitat and allowing grazing and timber activities. For 23% of the area, emphasis is on semi-primitive non-motorized recreation; no roading or impacting management is planned during the next 10 years. On 10% of the area, the emphasis is toward protection and enhancement of wildlife habitat; another 10% is allocated for protection of both wildlife and cultural resources. Timber production and enhancement of wildlife diversity is emphasized on 9%. For the remaining 7%, only natural processes are allowed; harvest of timber and fuelwood and grazing are prohibited.

The overall objective on the area is to demonstrate the concept of integrated forest protection on an operational basis. Specific objectives include:

* demonstrate to the public, "quality, on the ground management" at an operational level by implementing the principles of integrated forest protection.

* achieve better forest management at minimal cost by use of modern technology and planned District activities.

* through various interpretive methods, inform land managers and the general public about the complexity and functioning of natural ecosystems, the limits of our ability to control

those ecosystems and, in paricular, the effects of insects and diseases on various forest processes and resources.

APPENDIX IV

PURPOSE FOR A GEOGRAPHIC INFORMATION SYSTEM

The establishment of an Integrated Forest Protection Demonstration for the Bonito Project Area, Jemez Ranger District, Santa Fe National Forest provides a special opportunity to develop and test methods for assessing and mitigating the effects of several important forest pests, including dwarf mistletoes, root diseases, and western spruce budworm. Since the spatial distribution and abundance of these forest insects and diseases have important consequences on resource values and management, a geographic information system (GIS) is being designed for this area. In addition to being a useful research tool, a GIS could assist with site specific planning and monitoring, and could generate quality interpretative material. The large quantity of spatial information available and required to conduct this Demonstration suggests that a computer-assisted GIS would be desirable. In order to determine the required specifications of hardware, software, and data which would comprise this system, we are conducting a workload analysis in part through a survey of potential users of the system.

As a research tool, we expect that the system would facilitate access to the data from a number of proposed and completed pest-related studies on dwarf mistletoe, root disease, and western spruce budworm. These studies involve both pest population dynamics and their effects at the patch or gap-phase level, stand level, and landscape level. Several models would be developed from or linked with the GIS, including models for stand growth and yield, risk and hazard prediction, vegetation succession, habitat suitability, and visual quality. Some studies may require a fine resolution for display of groups of diseased trees; other studies may require a broad perspective to illustrate effects on visual quality at the vista scale. The system should be able to perform sophisticated mathematical procedures and should be accessible (directly or indirectly) from several locations. The titles of identified studies in the project area are listed below.

Current and Proposed Studies

Refinement of inventory procedures to provide necessary input data for the root disease model.

Foliage characteristics of the Douglas-fir ad white fir in the southwest and influence of dwarf mistletoe on those characteristics.

Evaluation of the severity of spruce budworm in relation to habitat types in the southwestern mixed conifer forests.

Incidence of root disease in and around compartment 417.1,, Jemez

Ranger District, Santa Fe Nation Forest.

Evaluation of wildlife activity in openings and along edges created by root disease.

Scenic attributes of root diseased stands.

Impacts of western spruce budworm on scenic beauty and recreation values.

Plant community responses to outbreaks of western spruce budworm in the southern Rocky Mountains.

Utility for aerial sketchmapping and photography to provide information on pest damage.

Sensitivity and validation of the budworm models with respect to dwarf mistletoe and southwestern stand conditions.

Assessment and empirical descriptions of the relationship between spruce budworm impact and stand ecological factors and conditions in the Front Range and Southwest.

Western spruce budworm, fire, and climatic interactions in the Front Range and Southwest.

Incorporation of scenic and recreation value impact assessment technology into decision support systems.

Cumulative effects of pests and forest management on forest health.

Post-budworm outbreak vegetation succession with respect to wildlife habitats in the Southwest.

APPENDIX V

SUMMARY OF RESPONES TO
QUESTIONNAIRE FOR
GIS NEEDS ASSESSMENT FOR THE INTEGRATED
FOREST PROTECTION DEMONSTRATION AREA, JEMEZ RANGER DISTRICT,
SANTA FE NATIONAL FOREST.
JULY 10, 1988

This paper contains a summary of responses to Part 1 of the GIS Needs Assessment Questionnaire. Part 2, the Inventory of Data has been summarized seperately and is contained elsewhere in the appendix of this report.

Part 1. Identification of User Requirements

1) What is your major interest or responsibility in the IFP area and GIS technology?

RESPONSES: Ranged from direct research in the IFP area to evaluation of GIS performance. Included ecological demonstration and visual analysis. Management personnel were concerned with applications; systems personnel were concerned more with technology transfer.

2) What are your principle management or research objectives for the IFP area?

RESPONES: Many are concerned with demonstration of IFP and model development for a variety of visual and ecological activities. Management objectives focused on IFP and multiple use applications. Research objectives were mainly ecological or directly related to the technology transfer itself.

3) Please indicate your primary responsibilit(ies)

2 ___A. Primary data collection/recording/mapping.

5 ___B. Analysis and mapping of one or more factors (themes) for the purposes of resource assessment or inventory.

3 ___C. Decision making for management and planning. Synthesizing information from resource specialists for the purpose of developing forest management plans.

4 ___D. Policy making. Establishing long term planning goals and objectives.

6 ___E. Research. Applied or basic research in forest resources.

RESPONSES: The numbers to the left of each choice represent

frequency counts. There is a heavy emphasis on reseach and analysis. Policy making and decision making for management and planning were the next most common. Primary data collection was the least frequent primary responsibility among the respondents.

4) The following table contains a list of output devices that may be required to achieve your management goals or research objectives.

Output Device	Quality	Priority	Frequency
Text Printer			
Graphics Printer			
Color Graphics Printer			
Single Pen Plotter	**********	**********	**********
* 11" x 17" format			
* 18" x 24" format			
* 24" x 36" format			
Multiple Pen Plotter	**********	**********	**********
* 11" x 17" format			
* 18" x 24" format			
* 24" x 36" format			
Electrostatic Plotter	**********	**********	**********
* color			
* monochrome			
Color slides			
Color video tape			

RESPONSES: With reguard to output quality, the overwhelming response was for publication quality. All respondents need publication quality. With respect to the plotters, color slides, and color video tape, the draft quality option is inapplicable.

Priority varied with device. The output device most frequently rated as essential was the text printer. Graphics printers and color slides were the next most frequently rated as high priority. The most frequent priority assignment for all plotter types was low. Most respondents indicated that electrostatic

plotters and color video tape were not required for their work.

Frequency of use was responded to as being monthly for all devices except the graphics printer for which the most frequent frequency response was weekly, and the text printer for which the most frequent response was daily. With the exception of these two printers, the second most frequent frequency of use response was weekly.

5) How would you rate your level of computer literacy? Please check appropriate description.

___ None

2 ___ Novice (learning applications)

3 ___ Intermediate (proficient in applications)

5 ___ Advanced (able to configure software; program macros)

___ Expert (routinely use one or more programming languages)

RESPONSES: Five respondents rated themselves as advanced. Five others rated themselves as novice or intermediate as indicated by the frequency counts to the left of the response area.

6) Please list the types of computer hardware that are currently used in your work. If you are knwoledgable about the systems, indicate the CPU, RAM, and disk capacity. In the Access column, indicate (s) for shared facilities and (p) for personal facilities.

Manufacturer/Series	CPU	RAM	Disk Storage capacity	Disk Storage load	Access

RESPONSES: The respondents indicated a variety of PC's, Apples, and the following mainframes or minis:

Vax
Data General
Cyber

Unisys

Most of the respondents could not provide full information in this area. Indications were that most hardware is not at full load and that much of the more powerful hardware is shared access.

7) What facilities or equipment do you feel are needed to enhance your capabilities? Please list in order of priority.

1. laser printers, GIS, digitizer, graphics work stations

2. pen plotter, image processing, digitizers

3. tape drives, video image capture, multipen plotter

4. system network

8) What type(s) of software are you currently using to meet your data processing requirements?

a) on a routine (weekly or monthly) basis

RESPONSES: Word processing and stats packages were the most frequent response. Others included spreadsheets, graphics, relational data bases, arc-info, moss, SPD, and FES.

b) on a special or irregular basis

RESPONSES: Several specialized or customized programs were mentioned including those for tree ring analysis, ecological, and meteorological applications. Other responses included mainframe graphics, PC graphics, Bitnet, paint, charts, spreadsheets, compilers, and 3-D graphics.

9) Please list in order of priority the types of software packages you wish to acquire for use in your work.

1. micro GIS, data handling, Grass, 3-D imaging, A-I

2. relational data bases, paint, perspective plots, multitasking environments

3. graphics, image processing

10) In the event that certain programs need to be customized to meet the needs of your work, would you prefer to do this modification in-house or on a contract basis?

RESPONSES: The most common response was on contract basis, a few with adequate support or programming experience indicated that they preferred in-house when possible.

11) What technical support do you have?

a) for data entry and processing

b) for computer programming and systems operation

RESPONSES: Ranged from none to limited, few of those who indicated limited support for programming have immediate access to such support.

This section requests information about statistical analysis requirments of your work.

12) Please indicate your level of proficiency with statistical software (e.g. SPSS, SAS, BMOP, SYSTAT, ect.)

1 ___ None

___ Novice (learning elementary functions)

3 ___ Intermediate (routine use of statistical functions)

4 ___ Advanced (design complex statistical analyses)

___ Expert (program statistical analysis procedures using high level programming languages)

RESPONSES: As indicated by the frequency counts above, those that responded are mainly in the intermediate to advanced level.

13) What types of basic and multivariate statistical functions and analyses are you using in your work (e.g. linear programming, analysis of variance, etc.)

RESPONSES: Statistical functions were specific to the user. Several mentioned various linear functions including linear programming, linear regression, time series, and ordination. Specialized mainframe stats and high level multivariate stats were mentioned by one respondent. SPSS is used by at least one respondent.

14) Are you satisfied with existing stats packages you are using? If not, list the package(s) you would prefer to use.

RESPONSES: The overwhelming response was that existing stats packages are satisfactory.

This section requests information about the use of Geographic Information Systems in your work.

15) What level of access and interaction with the GIS would you desire to achieve your objectives?

___ None (not needed)

2 ___ Infrequent (once a month or less)

5 ___ Routine (once a week or more)

1 ___ Heavy (use as a primary productivity tool)

RESPONSES: As indicated above, the most common projected access will be routine.

16) Please indicate your level of proficiency with GIS.

___ None

3___ Awareness (familiar with concept, but not a user)

2___ Novice (learning to use GIS operations)

2___ Intermediate (routine use of raster and vector operations)

1___ Advanced (proficient at modelling and integrating with DBMS)

___ Expert (research and development in spatial analysis systems)

RESPONSES: There is a heavy distribution at the lower end of the proficiency scale. The most common response was awareness, while only one respondent indicated that he was an advanced user.

The following is a list of GIS funcional capabilities. The list is organized by class and component of function. Under each component is a list of specific items of functional capability. For each functional item that you feel is required for your work, place the appropriate priority value in the space to the left of that item, using the legend below. This value is to correspond to the level of priority the applicable features will have in your work.

Priority values for functional table

1 high 2 medium 3 low

DATA CAPTURE

DIGITIZING
- ___ RASTER SCANNING
- ___ SOUND REGISTRATION
- ___ ATTRIBUTE ATTACHING
- ___ VALIDITY CHECKS
- ___ BATCH ENTRY
- ___ INTERACTIVE EDITING
- ___ ENDPOINT SNAPPING
- ___ USE RANGE OF INPUT DEVICES
- ___ DATA QUALITY INFORMATION
- ___ AUTO POLYGON GENERATION

TRANSPORT
- ___ FORMAT CONVERSION (GIS)
- ___ DEM INTERFACE
- ___ COMMUNICATION LINKS

EDITING
- ___ ON-LINE MODIFICATION
- ___ SLIVER REMOVAL
- ___ LABEL ALTERATION
- ___ ILLEGAL ATTRIBUTE CHECK
- ___ TABULAR UPDATE
- ___ RASTER UPDATE

RESPONSES: There is a heavy emphasis on data capture flexibility and editing capabilities. No respondents indicated a high priority on raster scanning functions.

DATA MANAGEMENT

STORAGE
- ___ FILE SET AS DATA BASE
- ___ THEMATIC ORGANIZATION
- ___ SPATIAL ORGANIZATION

UPDATE
- ___ STATUS REPORTS
- ___ SELECTIVE ADDITIONS
- ___ AUTOMATIC DATA INDEX

RETRIEVAL
- ___ SUPPORT SEQUENTIAL ACCESS
- ___ SUPPORT SPECIFIC ACCESS
- ___ FIELD VALUE CALCULATIONS
- ___ SHARED FIELD RELATION
- ___ FILE ATTRIBUTE SORTING
- ___ VARY SORT METHODS

RESPONSES: Respondents did not rate this category of functions as frequently for high priority as they did for data capture functions. However the distribution of high priority responses was evenly distributed throughout this category of functional capabilities.

DATA MANIPULATION

REDEFINITION
- ___ AUTO CONCATENATION
- ___ SPATIAL UNIT SELECTION
- ___ DATA LAYER SELECTION
- ___ ATTRIBUTE COMBINATION SELECTION

RESTRUCTURING
- ___ VECTOR/RASTER CONVERSION
- ___ COMPRESS/DECOMPRESS DATA
- ___ INTEGRATE DATA MODELS
- ___ SURFACE DATA FROM POINTS
- ___ COGO/GEOG CONVERSION
- ___ CELL SIZE MODIFICATION

RESPONSES: There was only a moderate emphasis on this group of functions.

ANALYTICAL TECHNIQUES

OVERLAY
___ BOOLEAN OPERATIONS
___ OPTIONAL WEIGHTING
___ LINE TO POLYGON OVERLAY
___ POINT TO POLYGON OVERLAY
___ FUZZY DATA HANDLING

NEIGHBORHOOD ANALYSIS
___ OPTIMUM ROUTES
___ SERVICE SHED MODELLING
___ VIEWSHED MODELLING
___ ASPECT ANALYSIS
___ SLOPE ANALYSIS
___ INTERPOLATION

STATISTICS
___ AREA/PERIMETER CALCS
___ PROBABILITY CALCULATIONS
___ OVERLAY AREA CALCULATIONS
___ DESCRIPTIVE STATISTICS
___ GENERAL STATISTICS
___ MULTIVARIATE STATISTICS
___ GRAPHIC OUTPUT

RESPONSES: This was the most heavily emphasized group of functional capabilities for all respondents. A variety of overlay, neighborhood and statistical analytical functions were reported to be of hight priority for most respondents.

DISPLAY

GENERATION
___ CREATE FILM TRANSPARENCIES
___ 3-D/PERSPECTIVE OUTPUT
___ VARIABLE VIEWPOINTS
___ HIDDEN LINE REMOVAL
___ PROFILE DISPLAY
___ GRAPHIC SCALING
___ GRAPHIC QUERY FUNCTIONS
___ MULTIPLE IMAGE OUTPUT
___ HALFTONING CONVERSION
___ IMAGE STORAGE FOR REPRO

ANNOTATION
___ GRAPHIC ANNOTATION
___ DEFINE FONTS/SYMBOLS
___ ALPHA/NUMERIC LABELS
___ AUTO POLYGON LABELLING
___ PLACE SHEET FURNITURE

RESPONSES: This category of functional capabilities was indicated to be of moderate importance to most respondents. The most frequently rated high priority functions were those related to 3-D output and graphic annotation.

APPENDIX VI

INTEGRATED FOREST PROTECTION DEMONSTRATION AREA
INVENTORY OF DATA

Forest Plan 1988

Source: S.O. Santa Fe
Type: spatial and tabular
Form: hardcopy
Location: S.O. Santa Fe

Extent: IFP area
Scale: 1/2" = 1 mile
Resolution: 10 acre
Categories: 100

Topography and Ownership 1987

Source: U.S.G.S.
Type: spatial
Form: hardcopy
Location: U.S.G.S.

Extent: IFP area
Scale: 1:24000
Resolution: 40' countour
Categories: 2

Logging Feasibility and Transportation 1986

Source: Jemez Ranger District
Type: spatial and tabular
Form: hardcopy
Location: Jemez Ranger District

Extent: IFP area
Scale: 1" = 1000'
Resolution: 2 acre
Categories: 16

Habitat Type 1986

Source: Jemez Ranger District
Type: spatial and tabular
Form: hardcopy
Location: Jemez Ranger District

Extent: IFP area
Scale: 1" = 1000'
Resolution: 2 acre
Categories: 22

Visual Quality Objectives 1983-1984

Source: S.O. Santa Fe
Type: spatial and tabular
Form: hardcopy and digital
Location: S.O. Santa Fe

Extent: Entire Forest
Scale: 1" = .5 mile
Resolution: 20-40 acre
Categories: 25

Visual Absorption Capability

Source: n/a
Type: spatial
Form: hardcopy
Location: S.O. Santa Fe

Extent: IFP area
Scale: 1" = 2000'
Resolution: 20-40 acre
Categories: 15

Existing Visual Condition

Source: n/a	Extent: IFP area
Type: spatial	Scale: 1" = 2000'
Form: hardcopy	Resolution: 10 acre
Location: S.O. Santa Fe	Categories: 12

Soil Type 1982

Source: S.O. Santa Fe	Extent: IFP area
Type: spatial and tabular	Scale: 1" = 1000'
Form: hardcopy	Resolution: 40 acre
Location: Jemez Ranger District	Categories: 35

Silviculture and Land Ownership

Source: Jemez R. D. and RMS	Extent: n/a
Type: tabular	Scale: n/a
Form: hardcopy	Resolution: n/a
Location: Jemez R. D. and RMS	Categories: 88

Insect and Disease Surveys 1987

Source: Jemez R. D. and RMS	Extent: IFP area
Type: tabular and spatial	Scale: 1" = 1000'
Form: hardcopy	Resolution: 2 acre
Location: Jemez R. D.	Categories: 12

Bonito Root Disease Survey 1987-1988

Source: RMS and Univ of Calif	Extent: Over 20 stands
Type: spatial and tabular	Scale: 1:3000
Form: hardcopy and digital	Resolution: 1/20 acre
Location: RWU 4501 RMS	Categories: 2

Los Conhcas Root Disease Survey 1973

Source: USDA R3-73-19	Extent: 26 acre plots
Type: tabular w/some maps	Scale: nts
Form: hardcopy	Resolution: 1/20 acre
Location: RWU 4501 RMS	Categories: 2

1935 Road Networks Jemez Mountains

Source: air photos,maps,records	Extent: 460,000 acres
Type: spatial	Scale: 1:24000
Form: hardcopy and digital	Resolution: primitive roads
Location: Bandelier Nat.'l Mon.	Categories: 4

1981 Road Networks Jemez Mountains

Source: air photos ground truth	Extent: 460,000 acres
Type: spatial	Scale: 1:24000
Form: hardcopy and digital	Resolution: primitive roads
Location: Bandelier Nat.'l Mon.	Categories: 4

1981 Land Use Jemez Mountains

Source: air photos ground truth	Extent: 250,000 acres
Type: spatial	Scale: 1:24000
Form: hardcopy and digital	Resolution: 40 acre
Location: Bandelier Nat.'l Mon.	Categories: 25

1935 Land Use Jemez Mountains

Source: air photos, maps, records	Extent: 250,000 acres
Type: spatial	Scale: 1:24000
Form: hardcopy and digital	Resolution: 40 acre
Location: Bandelier Nat.'l Mon.	Categories: 25

Tree Ring Width Chronologies

Source: Univ. of Ariz. Tree Ring	Extent: n/a
Type: tabular	Scale: n/a
Form: digital	Resolution: n/a
Location: Lab of Tree Ring Res.	Categories: one

Aerial Survey (updated annually)

Source: FPM Regional Office	Extent: All districts
Type: spatial	Scale: 1/2" = 1 mile
Form: hardcopy	Resolution: 10 trees
Location: FPM R.O. Albuquerque	Categories: varies

Important Viewpoints

Source: S.O. Santa Fe	Extent: IFP area
Type: spatial	Scale: 1:24000
Form: hardcopy	Resolution: points
Location: S.O.; Univ of Arizona	Categories: 5

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title FOREST PLAN

Data Source SANTA FE S.O.

Date Type SPATIAL AND TABULAR

Data Form HARDCOPY

Data Location SANTA FE S.O.

Data Date 1988

MAPPED DATA ONLY

Extent IFP AREA

Scale ½" = 1 MILE

Resolution 10 ACRES

How many different categories (data base fields or map attributes) are in this data set?

100

How reliable do you think this data is for your purposes?

VERY RELIABLE

How essential is this data for your management or research objectives?

ESSENTIAL

How useful is this information across a broad range of management or research objectives?

USEFUL

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title TOPOGRAPHY AND OWNERSHIP

Data Source U.S.G.S.

Date Type SPATIAL

Data Form DIGITAL AND HARDCOPY

Data Location U.S.G.S.

Data Date 1987

MAPPED DATA ONLY

Extent IFP AREA

Scale 1:24000 (DIGITAL)
1"=1000' (HARDCOPY)

Resolution 40' CONTOUR

How many different categories (data base fields or map attributes) are in this data set?

2

How reliable do you think this data is for your purposes?

VERY RELIABLE

How essential is this data for your management or research objectives?

ESSENTIAL

How useful is this information across a broad range of management or research objectives?

USEFUL AS BASE INFORMATION

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title LOGGING FEASIBILITY AND TRANSPORTATION PLAN (120 TIC PLAN)

Data Source JEMEZ RANGER DISTRICT

Date Type SPATIAL AND TABULAR

Data Form HARDCOPY

Data Location JEMEZ RANGER DISTRICT

Data Date 1986

MAPPED DATA ONLY

Extent IFP ACRES

Scale 1" = 1000'

Resolution 2 ACRE

How many different categories (data base fields or map attributes) are in this data set?

16

How reliable do you think this data is for your purposes?

ACCEPTABLE

How essential is this data for your management or research objectives?

ESSENTIAL

How useful is this information across a broad range of management or research objectives?

VERY USEFUL

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title HABITAT TYPE

Data Source JEMEZ R.D. RECON

Date Type SPATIAL AND TABULAR

Data Form HARDCOPY

Data Location JEMEZ RANGER DISTRICT

Data Date 1986

MAPPED DATA ONLY

Extent IFP AREA

Scale 1" = 1000'

Resolution 2 ACRE

How many different categories (data base fields or map attributes) are in this data set?

22

How reliable do you think this data is for your purposes?

ACCEPTABLE

How essential is this data for your management or research objectives?

ESSENTIAL

How useful is this information across a broad range of management or research objectives?

USEFUL

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title VISUAL QUALITY OBJECTIVES

Data Source SANTA FE, S.O. VQO MAPS

Date Type SPATIAL AND TABULAR

Data Form SPATIAL - HARDCOPY
TABULAR - DIGITAL (RIDS)

Data Location SUPERVISOR'S OFFICE SANTA FE

Data Date 1983 - 1984

MAPPED DATA ONLY

Extent ENTIRE FOREST

Scale 1" = .5 MILE

Resolution 20-40 ACRES

How many different categories (data base fields or map attributes) are in this data set?

25

How reliable do you think this data is for your purposes?

FAIR

How essential is this data for your management or research objectives?

ESSENTIAL

How useful is this information across a broad range of management or research objectives?

VERY USEFUL

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title VISUAL ABSORPTION CAPABILITY

Data Source N/A

Date Type SPATIAL

Data Form HARDCOPY

Data Location SUPERVISOR'S OFFICE, SANTA FE.

Data Date FUTURE

MAPPED DATA ONLY

Extent IFP AREA

Scale 1" = 2000'

Resolution 20 TO 40 ACRES

How many different categories (data base fields or map attributes) are in this data set?

15

How reliable do you think this data is for your purposes?

SATISFACTORY

How essential is this data for your management or research objectives?

ESSENTIAL

How useful is this information across a broad range of management or research objectives?

USEFUL

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title EXISTING VISUAL CONDITION

Data Source N/A

Date Type SPATIAL

Data Form HARDCOPY

Data Location SUPERVISOR'S OFFICE

Data Date FUTURE

MAPPED DATA ONLY

Extent IFP AREA

Scale 1" = 2000'

Resolution 10 ACRE

How many different categories (data base fields or map attributes) are in this data set?

12

How reliable do you think this data is for your purposes?

SATISFACTORY

How essential is this data for your management or research objectives?

ESSENTIAL

How useful is this information across a broad range of management or research objectives?

USEFUL IN FOREST WIDE MANAGEMENT

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title SOIL TYPE

Data Source SANTA FE, SUPERVISOR OFFICE

Date Type TABULAR AND SPATIAL

Data Form HARDCOPY

Data Location JEMEZ RANGER DISTRICT

Data Date 1982

MAPPED DATA ONLY

Extent IFP AREA

Scale 1" = 1000'

Resolution 40 ACRE

How many different categories (data base fields or map attributes) are in this data set?

35

How reliable do you think this data is for your purposes?

SOMEWHAT

How essential is this data for your management or research objectives?

VERY IMPORTANT

How useful is this information across a broad range of management or research objectives?

USEFUL

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title SILVICULTURAL AND LAND OWNERSHIP

Data Source JEMEZ R.D. AND RMS, FORT COLLINS

Date Type TABULAR

Data Form HARDCOPY

Data Location JEMEZ R.D. AND FORT COLLINS

Data Date

MAPPED DATA ONLY

Extent

Scale

Resolution

How many different categories (data base fields or map attributes) are in this data set?

88 MASTER STAND RECORD

How reliable do you think this data is for your purposes?

VERY GOOD

How essential is this data for your management or research objectives?

VERY IMPORTANT

How useful is this information across a broad range of management or research objectives?

VERY IMPORTANT TO PLANNING

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title INSECT + DISEASE SURVEYS

Data Source JEMEZ R.D. AND RMS, FORT COLLINS

Data Type TABULAR AND SPATIAL

Data Form HARDCOPY

Data Location JEMEZ RANGER DISTRICT OFFICE

Data Date 1987

MAPPED DATA ONLY

Extent IFP AREA

Scale 1" = 1000'

Resolution 2 ACRE

How many different categories (data base fields or map attributes) are in this data set?

12

How reliable do you think this data is for your purposes?

BEST AVAILABLE

How essential is this data for your management or research objectives?

VERY IMPORTANT

How useful is this information across a broad range of management or research objectives?

USEFUL

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title BONITO ROOT DISEASE SURVEY

Data Source BMS AND UNIVERSITY OF CALIFORNIA

Date Type SPATIAL AND TABULAR

Data Form HARD COPY AND DIGITAL

Data Location RWU 4501 FORT COLLINS

Data Date 1987-1988

MAPPED DATA ONLY

Extent MORE THAN 20 STANDS

Scale 1:3000

Resolution 1/20 ACRE

How many different categories (data base fields or map attributes) are in this data set?

2

How reliable do you think this data is for your purposes?

VERY

How essential is this data for your management or research objectives?

VERY

How useful is this information across a broad range of management or research objectives?

POTENTIALLY VERY USEFUL

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title LOS CONCHAS ROOT DISEASE SURVEY

Data Source BIOLOGICAL EVALUATION ARMILLARIA ROOT ROT, USFS, R3-73-19

Date Type TABULAR WITH SOME MAPS

Data Form HARDCOPY

Data Location RWU 4501 FORT COLLINS

Data Date 1973

MAPPED DATA ONLY

Extent 26 ACRE PLOTS

Scale NTS

Resolution 1/20 ACRE

How many different categories (data base fields or map attributes) are in this data set?

2 TREE SIZE AND CONDITION

How reliable do you think this data is for your purposes?

GOOD

How essential is this data for your management or research objectives?

USEFUL

How useful is this information across a broad range of management or research objectives?

UNKNOWN

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title 1935 ROAD NETWORKS JEMEZ MOUNTAINS

Data Source 1935 AIR PHOTOS, OLD MAPS, HISTORIC RECORDS

Date Type SPATIAL

Data Form HARDCOPY AND DIGITAL

Data Location BANDELIER NATIONAL MONUMENT, LOS ALAMOS

Data Date

MAPPED DATA ONLY

Extent 460,000 ACRES

Scale 1:24000

Resolution DOWN TO PRIMITIVE ROADS

How many different categories (data base fields or map attributes) are in this data set?

4

How reliable do you think this data is for your purposes?

ACCEPTABLE

How essential is this data for your management or research objectives?

IMPORTANT

How useful is this information across a broad range of management or research objectives?

POTENTIALLY USEFUL

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title 1981 ROAD NETWORKS JEMEZ MOUNTAINS

Data Source 1981 COLOR AIR PHOTOS GROUND-TRUTHED

Date Type SPATIAL

Data Form HARDCOPY AND DIGITAL

Data Location BANDELIER NATIONAL MONUMENT

Data Date

MAPPED DATA ONLY

Extent 460,000 ACRES

Scale 1:24000

Resolution DOWN TO PRIMITIVE ROADS

How many different categories (data base fields or map attributes) are in this data set?

4

How reliable do you think this data is for your purposes?

ACCEPTABLE

How essential is this data for your management or research objectives?

IMPORTANT

How useful is this information across a broad range of management or research objectives?

USEFUL

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title 1981 LANDUSE
JEMEZ MOUNTAINS

Data Source 1981 AIR PHOTOS
GROUND TRUTHED

Date Type SPATIAL

Data Form HARDCOPY AND DIGITAL

Data Location BANDELIER NATIONAL MONUMENT, LOS ALAMOS

Data Date

MAPPED DATA ONLY

Extent ~250,000 ACRES

Scale 1:24000

Resolution 40 ACRE

How many different categories (data base fields or map attributes) are in this data set?

25

How reliable do you think this data is for your purposes?

GOOD

How essential is this data for your management or research objectives?

ESSENTIAL

How useful is this information across a broad range of management or research objectives?

USEFUL

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title 1935 LAND USE
JEMEZ MOUNTAINS

Data Source 1935 AIR PHOTOS (1=31,680)
OLD MAPS, HISTORIC RECORDS

Data Type SPATIAL

Data Form HARDCOPY AND DIGITAL

Data Location BANDELIER NATIONAL MONUMENT, LOS ALAMOS N.M.

Data Date

MAPPED DATA ONLY

Extent ~ 250000 ACRES

Scale 1:24000

Resolution GENERALLY 40 ACRES

How many different categories (data base fields or map attributes) are in this data set?

25

How reliable do you think this data is for your purposes?

GOOD

How essential is this data for your management or research objectives?

ESSENTIAL

How useful is this information across a broad range of management or research objectives?

IT IS USEFUL

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title TREE RING WIDTH CHRONOLOGIES

Data Source LABORATORY OF TREE RING RESEARCH, UNIV. OF ARIZONA

Date Type TABULAR

Data Form DIGITAL

Data Location LABORATORY OF TREE RING RESEARCH, UNIV. OF ARIZONA

Data Date 1987-1988

MAPPED DATA ONLY

Extent

Scale

Resolution

How many different categories (data base fields or map attributes) are in this data set?

ONE - RING WIDTH VARIATION

How reliable do you think this data is for your purposes?

VERY RELIABLE

How essential is this data for your management or research objectives?

VERY ESSENTIAL

How useful is this information across a broad range of management or research objectives?

REASONABLY

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title AERIAL SURVEY

Data Source FPM - REGIONAL OFFICE

Date Type SPATIAL

Data Form HARDCOPY

Data Location FPM - REGIONAL OFFICE ALBUQUERQUE

Data Date UPDATED ANNUALLY

MAPPED DATA ONLY

Extent FORESTED AREAS OF ALL DISTRICTS

Scale 1/2" = 1 MILE

Resolution GROUPS OF 10 + TREES OR SMALLER

How many different categories (data base fields or map attributes) are in this data set?

VARIES WITH NUMBER OF PESTS

How reliable do you think this data is for your purposes?

GOOD ENOUGH FOR REGION-WIDE ESTIMATES

How essential is this data for your management or research objectives?

NOT ESSENTIAL BUT HELPFUL

How useful is this information across a broad range of management or research objectives?

VERY USEFUL IN BUDWORM MANAGEMENT FOR A VARIETY OF RESOURCES.

DATA INVENTORY FORM

Please provide information on both mapped data and tabular data that you will be using in the IFP demonstration.

Data Title IMPORTANT VIEWPOINTS

Data Source S.O. SANTA FE

Date Type SPATIAL

Data Form HARDCOPY

Data Location S.O. SANTA FE; UNIV OF ARIZONA PSYCHOLOGY DEPT.

Data Date 1988

MAPPED DATA ONLY

Extent IFP AREA

Scale 1:24000

Resolution POINTS

How many different categories (data base fields or map attributes) are in this data set?

5

How reliable do you think this data is for your purposes?

ACCEPTABLE

How essential is this data for your management or research objectives?

ESSENTIAL

How useful is this information across a broad range of management or research objectives?

NOT DIRECTLY

APPENDIX VII
LIST OF RESPONDENTS TO USER SURVEY

1. Craig D. Allen
Research Ecologist
Bandelier National Monument
Los Alamos, NM 87544-9701
(505) 672-3861

2. Bernie Connell
Research Meteorologist/Forester
USFS Rocky Mountain Forest and Range Experiment Station
240 W. Prospect
Ft. Collins, Co. 80526
(303) 224-1186

3. Jerome S. Beatty (Douglas Parker)
New Mexico Zone Leader - FPM
USDA Forest Service, FPM
517 Gold Avenue, SW
Albequerque, NM 87102
(505) 842-3289

4. Terry Daniel
Professor of Psychology
Department of Psychology
University of Arizona
Tucson, AZ 85721
(602) 621-7453

5. Brian W. Geils
Research Plant Pathologist
240 W. Prospect
Fort Collins, Co 80521
(303) 224-1247

6. Paul Gobster
Research Social Scientist
North Central Forest Experiment Station
5801 N. Pulaski Rd.
Chicago, IL 60646
(312) 588-7650

7. Michael J. Morrison
Forester
Jemez Ranger District
P.O. Box 98
Jemez Springs, NM 87025
(505) 829-3535

8. Thomas M. Mott
Santa Fe Forest Timber Staff
P.O. Box 1689
Santa Fe, NM 87501
(505) 988-6953

9. R. Eugene Rockey
Systems Analyst
11177 W. 8th Avenue
Lakewood Co. 80225
PO Box 25127
(303) 236-9495 FTS 776-9495

10. Thomas W. Swetnam
Assistant Professor
Laboratory of Tree-Ring Research
University of Arizona
Tucson, AZ 85721
(602) 621-2112